Base Load Power Hub (BLPH)

Mechanical Completion Instrument Calibration & Testing Procedure

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1. PROJECT OUTLINE DESCRIPTION

Crosswind, a Shell and Eneco joint-venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.
Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1 PROJECT LOCATION

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

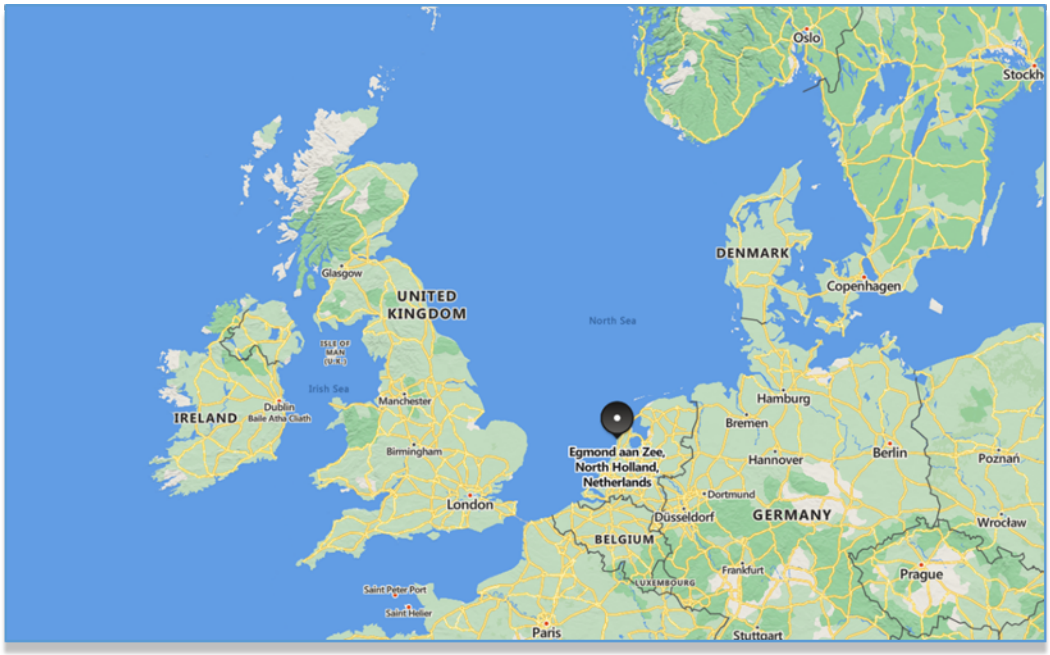


Figure 1 *- HOLLANDSE KUST NOORD WIND PARK Location Map*

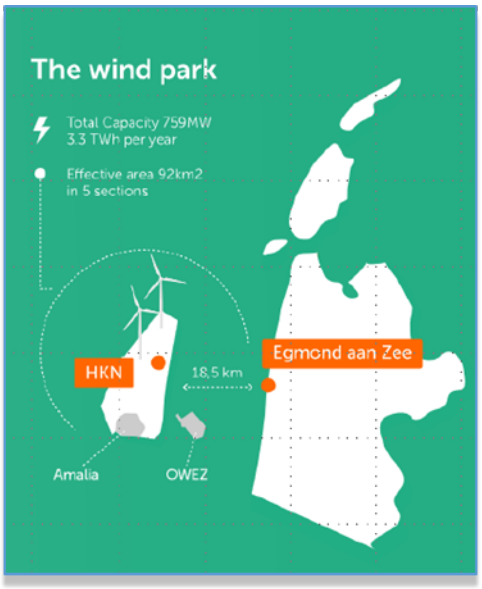


Figure 2 *- Wind Park Details*

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile is located on coordinates E 590719.1, N 5841602.3 and is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.2 PROJECT CONCEPT

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

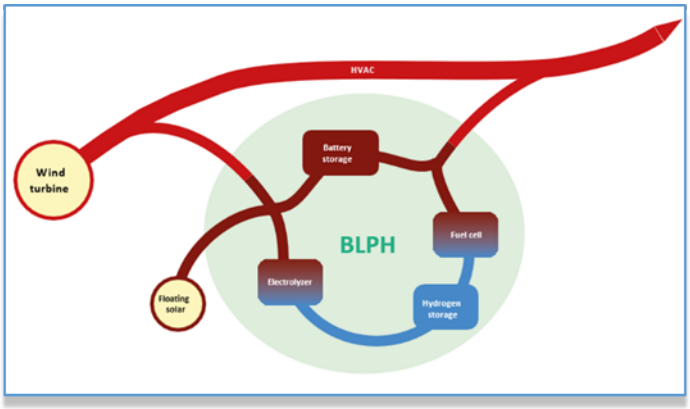


Figure 3 - BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.
The purpose of the BLPH is to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. SCOPE

Scope of this Mechanical Completion specification is to provide the general requirements and technical prescriptions covering execution and testing for the installation of instrument systems to be provided for the project.
Applicable International Standards and Codes shall be considered as an integral part of this specification.
The erection works shall be performed according to good engineering practice.

3. TERMS & DEFINITIONS

Terms and definitions enlisted hereunder may be applied and used in this document:

Terms	Definitions
COMPANY (CPY)	Means CROSSWIND C.V., owner & developer of the offshore WIND FARM Hollandse Kust Noord Wind Park Project.
CONTRACTOR (CTR)	Means ROSETTI MARINO S.p.A., the named party with whom COMPANY will place a contract for engineering, procurement, construction, offshore installation & Commissioning of the facilities associated with the PROJECT.
PROJECT	Refers to the BASE LOAD POWER HUB (BLPH) project.
Inspection and Test Plan (ITP)	Document that identifies the activities to be inspected as well as specifications, methods and acceptance criteria for monitoring and/or testing. It is a synonymous of "Quality Control Plan" (QCP)
VENDOR	means any CONTRACTOR's and/or SUBCONTRACTORS' supplier(s) of CONTRACTOR ITEM(s).

4. REFERENCES DOCUMENTS

123A90-PML-PM-LIS-01001	Master Document Register
123A90-PML-COM-PRO-03007	Commissioning Strategy
123A90-PML-COM-PL-03002	Mechanical Completion & Commissioning Execution Plan
123A90-PML-QHSE-SP-00118	Mechanical Completion ITR Template Collection
123A90-PML-COM-LIS-03011	System/Sub-Systems List
123A90-PML-COM-LIS-03012	System/Sub-System Boundary Limit Diagrams
123A90-PML-QHSE-PRO-00120	PROVERLIS Management Procedure
123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier
123A90-PML-QHSE-PL-00119	ATEX Implementation Plan
123A90-PML-QHSE-PRO-00107	Final Dossier Procedure

5. CHECK, TEST AND CALIBRATION OF INSTRUMENTS

5.1 INTERNATIONAL CODES / NORMS / STANDARD

ASME B 1.20.1	Pipe treads
ASME B 16.5	Steel pipe flange and flanged fitting
ASME B 46.1	Surface texture (surface roughness, wavinex & lay)
API RP 551	Process measurement
ANSI/ISA-12.27	Requirements for process sealing between electrical systems and flammable or combustible process fluid
API RP 554	Process Instrumentation and Control
IEC 60079-14	Electrical installations design, selection and erection
IEC 60079- 17	Electrical installations inspection and maintenance
IEC 60529	Degree of protection provided by enclosure

5.2 CHECK, TEST AND CALIBRATION OF INSTRUMENTS PROCEDURE

The following checks, functional tests and calibrations performed on instruments, shall be executed to demonstrate that the instrumentation system will perform as designed and it is conform to the intent of the Project specifications and drawings.

Instrument calibration will be performed only in case Vendor did not provide calibration certificate. If Vendor's certificates are available, CTR will perform only tags and setting checks on devices (units compare to the data sheet, hart communicator).

Equipment and instruments used for testing and calibration shall have the required accuracy. Testing equipment shall be inspected and calibrated by a recognized third party laboratory, in compliance with CPY's approved standards.

It will be responsibility of the CTR to replace damaged test equipment and maintain at site all instrument valid calibration certificates (not expired).

The forms shall be signed by SUB-CONTRACTOR, CTR and CPY.

5.3 PRELIMINARY CHECK AND CALIBRATION

Before installation, all the instruments shall be visually checked to verify their conservation and compliance with technical specifications.

In particular:

1. Tag number
2. Model and record in form
3. Serial number and record in form
4. Hazardous area requirement
5. IP compliance
6. Mechanical damage
7. Process connection
8. Electric connection

The supplier shall perform functional tests mandatorily, in the absence of certification. These tests shall be carried out before installation on the following instruments:

- Pressure Transmitter functional tests*
- Differential Pressure Transmitter functional tests*
- Temperature Transmitter functional tests*
- Level Transmitter functional tests*
- Flow Transmitter functional tests*
- Pressure Gauge (if applicable) functional tests*
- Temperature Gauge (if applicable) functional tests*
- Level Gauge (if applicable) functional tests*
- Flow Gauge functional tests*

**Note: on all flanged items will be performed only visual check, not functional tests.*

If the calibration certificate by Vendor is available, it will be only necessary:
tags and setting checks for all devices (units compare to the data sheet, hart communicator)

If the calibration certificate by Vendor is not available, activity will be performed as follow:

- ***PRESSURE TRANSMITTER***

Documentation check as follows:

- Data sheet should be available and be recorded with the task **TJX04-Analogue O/P** in a section named “DATA”, row DATA SHEET N°:” relative number of document with revision number
- Calibration certificate by Vendor

Pressure transmitter shall be electrically connected to:

- 24 Vdc generator
- Ammeter reading 0÷20 mA scale with proper accuracy.
- Hart communicator should be connected for digital signal (use an adequate resistance)
- Wiring and tightness (in compliance with Vendor manual)

Pressure transmitter shall be connected with hydraulic or pneumatic circuit as follow:

- Pressure generator (pump, tork)
- Pressure reading gauge (acceptable for range and accuracy)
- Valves for intercepting and for vent
- Pipe, fitting connected and tightened

Before starting with test, check:

1. Electric supply is on
2. Ammeter is on and reading values (into a range of 4 - 20 mA)
3. Hart communicator is on and connected with the instrument
4. Hydraulic or pneumatic circuit is connected and tightened without leakage
5. Model and serial number of calibrated instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, third row (“MODEL N°”, “SERIAL N°”)
6. Model and serial number of reference instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, fifth row (“TEST EQUIPMENT”, “SERIAL N°”)
7. Reference measuring unit should be recorded with the task **TJX04-Analogue O/P** in section “TEST DETAILS”, in the row “Input A” column “Units” **BARg** and in the row “Output” column “Units” **mA**

Start the test as follows:

1. Release completely pressure to the instrument and check zero output, should be 4mA, record as follows:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the first cell of “RISING”, record the value reading in pressure gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output” in the first cell of “RISING”, record the value reading in ammeter

2. Increase the pressure of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record as follows:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the second cell of “RISING”, record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output” in the second cell of “RISING”, record the value reading in ammeter

3. Increase pressure to the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record as follows:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the third cell of “RISING”, record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output” in the third cell of “RISING”, record the value reading in ammeter .

4. Increase the pressure of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record as follow:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the fourth cell of “RISING”, record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in the fourth cell of “RISING”, record the value reading in ammeter

5. Increase the pressure of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record as follows:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a fifth cell of “RISING”, record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a fifth cell of “RISING”, record the value reading in ammeter

6. Increase and after decrease the pressure of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record as follows:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the first cell of “FALLING”, record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output” in the first cell of “FALLING”, record the value reading in ammeter

7. Decrease the pressure of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record as follows:

   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the second cell of “FALLING” record the value reading in pressure gauge

   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output” in the second cell of “FALLING”, record the value reading in ammeter

8. Decrease the pressure of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record as follows:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the third cell of “FALLING”, record the value reading in pressure gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in the third cell of “FALLING”, record the value reading in ammeter

9. Decrease the pressure of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record as follows:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the fourth cell of “FALLING”, record the value reading in pressure gauge

b) Task **TJX04-Analogue O/P** in CALIBRATION FIGURES“ on the line of “output” in the fourth cell of “FALLING”, record the value reading in ammeter

10. Decrease pressure of the instrument till 0% of range read on the instrument datasheet, output should be 4mA, record as follows:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in the fifth cell of “FALLING”, record the value reading in pressure gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in the fifth cell of “FALLING” record the value reading in ammeter

- Check correct parameter within the communicator in particular:
  - Correct tag
  - Safety position under fault as per data sheet
- Check that indicator visualization is correct as per value and unit

After test as follows:

Fix a label with date and signature on the instrument tested then in the Task **TJX04-Analogue O/P** cross “TESTED LABEL AFFIXED” cell.

Attach to the Task **TJX04-Analogue O/P** the relative data sheet page and cross “DATA SHEET ATTACHED” cell.

Complete with date and signatures of involved people.

➢ *DIFFERENTIAL PRESSURE TRANSMITTER*

Documentation check as follows:

- Data sheet should be available and be recorded with the task **TJX04-Analogue O/P** in a section named “DATA”, row DATA SHEET N°:” relative number of document with revision number
- Calibration certificate by Vendor

Differential pressure transmitter shall be electrically connected to:

- 24 Vdc generator
- Ammeter reading 0÷20 mA scale with properly accuracy
- Hart communicator should be connected for digital signal (use an adequate resistance)
- Wiring and tightness (in compliance with vendor manual)

Differential pressure transmitter shall be connected with hydraulic or pneumatic circuit as follows:

- Pressure generator (pump, tork)
- Pressure reading gauge (with acceptable range and accuracy)
- Valves for interception and for vent
- Pipe and fitting connected and tightened
- Connection of pressure generator to the right side of instrument

Before starting with test, check:

1. Electric supply is on
2. Ammeter is on and reading values (into a range of 4 - 20 mA)
3. Hart communicator is on and connected with the instrument
4. Hydraulic or pneumatic circuit is connected and tightened without leakage
5. Model and serial number of calibrated instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, third row (“MODEL N°”, “SERIAL N°”)
6. Model and serial number of reference instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, fifth row (“TEST EQUIPMENT”, “SERIAL N°”)
7. Reference measuring unit should be recorded with Task **TJX04-Analogue O/P**, section “TEST DETAILS”, row “input A” and column “UNITS**”**, in the row “Input A” column “Units” **mmH2O** or **mBAR** and in the row “Output” column “Units” **mA**

Start the test as follow:

1. Completely release the pressure of the instrument and check, zero output should be 4mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, first cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, first cell of “RISING”, record the value reading in ammeter
2. Increase pressure of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, second cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES”, line of “output”, second cell of “RISING”, record the value reading in ammeter
3. Increase pressure of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES”, line of “Input A”, third cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, third cell of “RISING”, record the value reading in ammeter

4. Increase pressure of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, fourth cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fourth cell of “RISING”, record the value reading in ammeter
5. increase pressure of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, fifth cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fifth cell of “RISING”, record the value reading in ammeter
6. Increase and after decrease pressure of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES”, line of “Input A”., first cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, first cell of “FALLING”, record the value reading in ammeter
7. Decrease pressure to the instrument till 75% of range read on the instrument datasheet, output should be 16mA record as follow:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, second cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, second cell of “FALLING”, record the value reading in ammeter
8. Decrease pressure to the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, third cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, third cell of “FALLING”, record the value reading in ammeter
9. Decrease pressure of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, fourth cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fourth cell of “FALLING”, record the value reading in ammeter
10. Decrease pressure to the instrument till 0% of range read on the instrument datasheet, output should be 4mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES”, line of “Input A”, fifth cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fifth cell of “FALLING”, record the value reading in ammeter

- Check correct parameter within the communicator in particular:
  - Correct tag
  - Safety position under fault as per data sheet
- Check that indicator visualization is correct as per value and unit

After test as follow:

Fix a label on the instrument tested with date and signature and in the Task **TJX04-Analogue O/P,** cross "TESTED LABEL AFFIXED" cell.

Attach to the Task **TJX04-Analogue O/P** the relative data sheet page and cross "DATA SHEET ATTACHED" cell.

Complete date and signature of involved people.

➢ *TEMPERATURE TRANSMITTER*

Documentation check as follow:

- Data sheet should be available and be recorded with the task **TJX04-Analogue O/P** in a section named "DATA", row DATA SHEET N°:" relative number of document with revision number
- Calibration certificate by Vendor

Temperature transmitter shall be electrically connected to:

- 24 Vdc generator.
- Ammeter reading 0÷20 mA scale with properly accuracy.
- Hart communicator should be connected for digital signal (use an adequate resistance).
- Wiring and tightness (in compliance with vendor manual).

Temperature transmitter shall be inserted in a heat generator with available thermometer

Before starting with test, check:

1. Electric supply is on
2. Ammeter is on and reading values (verify ambient temperature with related value in mA)
3. Hart communicator is on and connected with the instrument
4. The temperature element is in heat generator with thermometer
5. Model and serial number of calibrated instrument should be recorded with the task **TJX04-Analogue O/P** in a section named "Data", third row ("MODEL N°", "SERIAL N°")
6. Model and serial number of reference instrument should be recorded with the task **TJX04-Analogue O/P** in a section named "Data", fifth row ("TEST EQUIPMENT", "SERIAL N°")
7. Reference measuring unit should be recorded with Task **TJX04-Analogue O/P**, section "TEST DETAILS", row "input A" and column "UNITS**"**, in the row "Input A" column "Units" **C°** and in the row "Output" column "Units" **mA**

Start with test as follows:

1. Leave the element of transmitter in ambient, output should correspond to the measured temperature value and recorded as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, first cell of “RISING”, record the value reading in thermometer
    b) Task**TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, first cell of “RISING”, record the value reading in ammeter
2. Increase the temperature of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, third cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Output”, third cell of “RISING”, record the value reading in ammeter

    If ambient temperature is above this value, does not have to be recorded

3. Increase temperature of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES”, line of “Input A”, fifth cell of “RISING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fifth cell of “RISING”, record the value reading in ammeter
4. Increase and after decrease the temperature of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a first cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output”,first cell of “FALLING”, record the value reading in ammeter
5. Decrease the temperature of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, third cell of “FALLING”, record the value reading in pressure gauge
    b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, third cell of “FALLING”, record the value reading in ammeter

    If ambient temperature is above this value does not have to be recorded

6. Leave the element of transmitter in ambient, output should correspond to the measured temperature value; record data as follows:
    c) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “Input A”, fifth cell of “FALLING”, record the value reading in pressure gauge
    d) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“, line of “output”, fifth cell of “FALLING”, record the value reading in ammeter

- Check correct parameters within the communicator, in particular:
  - Correct tag

- Safety position under fault as per data sheet

- Check that indicator visualization is correct as per value and unit

After test as follow:

Fix a label on the instrument tested with date and signature and in the Task **TJX04-Analogue O/P**, cross "TESTED LABEL AFFIXED" cell.

Attach to the Task **TJX04-Analogue O/P** the relative data sheet page and cross "DATA SHEET ATTACHED" cell.

Complete with date and signatures of involved people.

➢ *LEVEL TRANSMITTER*

TYPES & DESCRIPTION

We are considering only the following types of LTs:

I. Radar Level Transmitter

II. Magnetic Level Transmitter

I. In the Radar Level Transmitter, distance to the surface is measured by short radar pulses, which are transmitted from the antenna to the tank top. When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected back to the transmitter. The time difference between the transmitted and the reflected pulse is proportional to the distance, from which the level, volume and level rate, are calculated.

II. The Magnetic Level Transmitter consists of the following main parts: float with magnet, measuring tube, and mounting flange with electronics.
The measuring tube, which is mounted on the top of the tank, incorporates a number of resistors and reed switches.
A float with a permanent ring magnet moves on the outside of the measuring tube. When the level changes the magnet in the float will activate a reed switch, which will connect a number of resistors, giving an ohmic value corresponding to the level. In the connection head an R/I transmitter is mounted and converts the signal into a standard 4 - 20 mA.

Documentation check as follows:

- Data sheet should be available and be recorded with the task **TJX04-Analogue O/P** in a section named "DATA", row DATA SHEET N°:" relative number of document with revision number
- Calibration certificate by Vendor

Level transmitter shall be electrically connected to:

- 24 Vdc generator
- Ammeter reading 0÷20 mA scale with properly accuracy
- Hart communicator should be connected for digital signal (use a adequate resistance)
- Wiring and tight (in compliance with vendor manual)

Before starting with test, check:

1. Electric supply is on
2. Ammeter is on and reading values (into a range of 4 - 20 mA)
3. Hart communicator is on and connected with instrument
4. Tank or Vessel Height must be known as per Data Sheet or Project Drawings
5. Model and serial number of calibrated instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, third row (“MODEL N°”, “SERIAL N°”)
6. Model and serial number of reference instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, fifth row (“TEST EQUIPMENT”, “SERIAL N°”)
7. Reference measuring unit should be recorded with Task **TJX04-Analogue O/P**, section “TEST DETAILS”, row “input A” and column “UNITS**”**, in the row “Input A” column “Units” **Level%** or **Volume (Cubic Meters or Litres)** and in the row “Output” column “Units” **mA**

Start the test as follows:

1. Put the instrument on a horizontal place and measure the distance, to simulate right height, then put a square piece of consistent material (i.e. carton) to read low level.
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ in the line of “Input A” in a first cell of “RISING”, record the value reading in level gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ in the line of “Output”, first cell of “RISING”, record the value reading in ammeter
2. Decrease the level distance of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record as follows:
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A”, second cell of “RISING”, record the value reading in level gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ in the line of “Output”, second cell of “RISING”, record the value reading in ammeter
3. Decrease the level distance of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record as follows:
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A”, third cell of “RISING”, record the value reading in level gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a third cell of “RISING” record the value reading in ammeter .
4. Decrease the level distance of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record data as follows:
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a fourth cell of “RISING” record the value reading in level gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a fourth cell of “RISING” record the value reading in ammeter .
5. Decrease the level distance of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a fifth cell of “RISING” record the value reading in level gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a fifth cell of “RISING” record the value reading in ammeter .

6. Increase level distance to the instrument till 75% of range read on the instrument datasheet , output should be 16 mA record as follow:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a second cell of “FALLING” record the value reading in level gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a second cell of “FALLING” record the value reading in ammeter.

7. Increase level distance the instrument till 50% of range read on the instrument datasheet, output should be 12 mA record as follow:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a third cell of “FALLING” record the value reading in level gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a third cell of “FALLING” record the value reading in ammeter .

8. Increase level distance to the instrument till 25% of range read on the instrument datasheet, output should be 8 mA record as follow:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a fourth cell of “FALLING” record the value reading in level gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output”, in a fourth cell of “FALLING” record the value reading in ammeter.

9. Increase level distance to the instrument till 0% of range read on the instrument datasheet, output should be 4 mA record as follow:

a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A” in a fifth cell of “FALLING” record the value reading in level gauge

b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output” in a fifth cell of “FALLING” record the value reading in ammeter.

- Check correct parameter within the communicator, in particular:
  - Correct tag
  - Safety position under fault as per data sheet
- Check that indicator visualization is correct as per value and unit

After test as follows:

Fix a label on the instrument tested with date and signature and in the Task **TJX04-Analogue O/P,** cross “TESTED LABEL AFFIXED” cell.

Attached to the Task **TJX04-Analogue O/P** the relative data sheet page and cross “DATA SHEET ATTACHED” cell.

Complete with date and signatures of involved people.

- ***FLOWMETER TRANSMITTER***

Documentation check as follows:

- Data sheet should be available and be recorded with the task **TJX04-Analogue O/P** in a section named “DATA”, row DATA SHEET N°:” relative number of document with revision number
- Calibration certificate by Vendor

Flow transmitter shall be electrically connected to:

- 24 Vdc generator
- Ammeter reading 0÷20 mA scale with proper accuracy
- Hart communicator should be connected for digital signal (use an adequate resistance)
- Wiring and tightness (in compliance with vendor manual)

Before starting with test, check:

1. Electric supply is on
2. Ammeter is on and read value (into a range of 4 - 20 mA)
3. Hart communicator is on and connected with instrument
4. Hydraulic or pneumatic circuit is connected and tightened without leakage
5. Check right flow direction on FT
6. Model and serial number of calibrated instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, third row (“MODEL N°”, “SERIAL N°”)
7. Model and serial number of reference instrument should be recorded with the task **TJX04-Analogue O/P** in a section named “Data”, fifth row (“TEST EQUIPMENT”, “SERIAL N°”)
8. Reference measuring unit should be recorded with Task **TJX04-Analogue O/P**, section “TEST DETAILS”, row “input A” and column “UNITS**”**, in the row “Input A” column “Units” **Cubic meters/hours (depends of Flow rate)** and in the row “Output” column “Units” **mA**

Start the test as follows:

1. Release completely the flow to the instrument and check zero output, should be 4mA. Record data as follows:
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A”, first cell of “RISING”, record the value reading in flow gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “output”, first cell of “RISING”, record the value reading in ammeter
2. Increase flow of the instrument till 25% of range read on the instrument datasheet, output should be 8 mA, record data as follows:
   a) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Input A”, second cell of “RISING” record the value reading in flow gauge
   b) Task **TJX04-Analogue O/P** in “CALIBRATION FIGURES“ on the line of “Output”, second cell of “RISING”, record the value reading in ammeter

3. Increase the flow of the instrument till 50% of range read on the instrument datasheet, output should be 12 mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Input A", third cell of "RISING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Output", third cell of "RISING", record the value reading in ammeter
4. Increase the flow of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Input A", fourth cell of "RISING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Output", fourth cell of "RISING", record the value reading in ammeter
5. Increase the flow of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Input A", fifth cell of "RISING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Output", fifth cell of "RISING", record the value reading in ammeter
6. Increase the flow and after decrease pressure of the instrument till 100% of range read on the instrument datasheet, output should be 20mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Input A", first cell of "FALLING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Output", first cell of "FALLING", record the value reading in ammeter
7. Decrease the flow of the instrument till 75% of range read on the instrument datasheet, output should be 16mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Input A", second cell of "FALLING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES" on the line of "Output", second cell of "FALLING", record the value reading in ammeter
8. Decrease the flow of the instrument till 50% of range read on the instrument datasheet, output should be 12mA, record data as follows:
    c) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Input A", third cell of "FALLING", record the value reading in flow gauge
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Output", third cell of "FALLING", record the value reading in ammeter
9. Decrease the flow of the instrument till 25% of range read on the instrument datasheet, output should be 8mA, record as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Input A", fourth cell of "FALLING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "output", fourth cell of "FALLING", record the value reading in ammeter

10. Decrease the flow of the instrument till 0% of range read on the instrument datasheet, output should be 4mA, record data as follows:
    a) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "Input A", fifth cell of "FALLING", record the value reading in flow gauge
    b) Task **TJX04-Analogue O/P** in "CALIBRATION FIGURES", on the line of "output", fifth cell of "FALLING", record the value reading in ammeter

- Check correct parameter within the communicator in particular:
  - Correct tag
  - Safety position under fault as per data sheet
- Check that indicator visualization is correct as per value and unit

After test as follow:

Fix a label on the instrument tested with date and signature and in the Task **TJX04-Analogue O/P,** cross "TESTED LABEL AFFIXED" cell.

Attach to the Task **TJX04-Analogue O/P** the relative data sheet page and cross "DATA SHEET ATTACHED" cell.

Complete with date and signatures of involved people.

- ***PRESSURE GAUGE***
  - ➔ *See Pressure Transmitter*
- ***TEMPERATURE GAUGE***
  - ➔ *See Temperature Transmitter*
- ***LEVEL GAUGE***
  - ➔ *See Level Transmitter*
- ***FLOW GAUGE***
  - ➔ *See Flowmeter Transmitter*